

CLAIMS

1. An separation device to separate components of a mixture of particulates, said device including means to separate said particulates by electrostatic and or magnetic means in association with first, second, third and fourth rolls, said first and second roll being arranged one above the other and each producing a non-conductive output and a conductive output and or a magnetic and a non-magnetic output, which proceed respectively to said third roll and said fourth roll, with said first and second rolls producing a mids output, said mids output from said first roll proceeding onto said second roll.
2. A device as claimed in claim 1, wherein each roll operating with both electrostatic and magnetic separation means is made from a material which is non magnetic and conductive, such as for example stainless steel or is made from a material which is magnetic and conductive and includes means to separate magnetic particles from said roll.
3. A device as claimed in claim 1 or 2, wherein each roll operating solely with magnetic separation means is made from a non magnetic material or is made from a magnetic material and includes means to separate magnetic particles from said roll.
4. A device as claimed in any one of claims 1 to 3, wherein each roll operating solely with electrostatic separation means is made from a conductive material.
5. A device as claimed in any one of claims 1 to 4, wherein first and second rolls are conductive and have electrostatic separation means associated therewith.
6. A device as claimed in claim 5, wherein said first and second rolls do not re-treat either of the conductive or non-conductive outputs.
7. A device as claimed in any one of claims 1 to 6, wherein said third and fourth rolls are conductive and have electrostatic separation means associated therewith
8. A device as claimed in claim 7, wherein non-conductive output from the fourth roll, and conductive output from the third roll joins into a single output with the mids output from the second roll.
9. A device as claimed in any one of claims 1 to 8, wherein said fourth roll is a conductor cleaner and the third roll is a non-conductor cleaner.
10. A device as claimed in any one of claims 1 to 9, wherein said third roll has a non-conductive, a mids, and a conductive output, or just a conductive and a non-conductive output.

11. A device as claimed in any one of claims 1 to 10, wherein said fourth roll has a conductive, a mids, and a non-conductive output, or just a conductive and a non-conductive output.
12. A device as claimed in any one of claims 1 to 11, wherein said third and fourth rolls operate with magnetic separation means.
13. A device as claimed in claim 12, wherein non-magnetic output from the fourth roll, and magnetic output from the third roll joins into a single output with a mids output from the second roll.
14. A device as claimed in claim 13, wherein said fourth roll is a magnetic cleaner and the third roll is a non-magnetic cleaner.
15. A device as claimed in claim 13 or 14, wherein magnetic output from the fourth roll, and non-magnetic output from the third roll joins into a single output with a mids output from the second roll.
16. A device as claimed in claim 15, wherein said fourth roll is a non-magnetic cleaner and the third roll is a magnetic cleaner.
17. A device as claimed in any one of claims 1 to 16, wherein said third roll has a magnetic and a non-magnetic output.
18. A device as claimed in claim 17, wherein said third roll also includes a mids output.
19. A device as claimed in any one of claims 1 to 18, wherein said fourth roll has a magnetic and a non-magnetic output.
20. A device as claimed in claim 19, wherein said fourth roll also includes a mids output.
21. A device as claimed in any one of claims 1 to 20, wherein said first and second rolls operate with magnetic separation means and do not re-treat either of the magnetic or non-magnetic outputs.
22. A device as claimed in any one of claims 1 to 21, wherein said device is utilised in a separation plant as a primary stage or roughing stage and or a re-treatment stage.
23. A device as claimed in any one of claims 1 to 22, wherein said electrostatic separation means includes one or a combination of two or more of the following: an ionising electrode; tribo-electric mechanism; electrostatic plate separator; or other appropriate means so as to positively or negatively charge or polarise said particulates.
24. A separation plant including at least one device as claimed in any one of claims 1 to 22

25. A separation plant as claimed in claims 23, whereby the mids output of said device is fed to a high tension separation device.
26. A plant as claimed in claim 24, wherein a conductive output of the high tension separation device can be fed to an electrostatic plate machine.
27. A method of separating particulates from a mixture of particulates, said method including the steps of passing same over first, second third and fourth rolls which are associated with electrostatic and or magnetic separation means, whereby the non-conductive output and conductive output and or the magnetic output and non-magnetic output of said first roll bypasses said second roll, said second roll processing only a mids output from said first roll.
28. A method as claimed in claim 27, wherein there is included a step of passing the non-conductive output of said first and second rolls to a third roll, while conductive output of said first and second rolls is passed to a fourth roll.
29. A method as claimed in claim 27 or 28, wherein said non-conductive output from the fourth roll, and the conductive output from the third roll, join into a single stream with a mids output from the second roll.
30. A method as claimed in any one of claims 27 to 29, wherein said fourth roll is a conductor cleaner and said third roll is a non-conductor cleaner.
31. A method as claimed in any one of claims 27 to 30, wherein said third roll has three outputs being non-conductive, a mids, and a conductive output.
32. A method as claimed in any one of claims 27 to 31, wherein said third roll has only two outputs being a conductive and a non-conductive output.
33. A method as claimed in any one of claims 27 to 32, wherein said fourth roll has three outputs being a conductive, a mids, and a non- conductive output.
34. A method as claimed in any one of claims 27 to 33, wherein said fourth roll has only two outputs being a conductive and a non-conductive output.
35. A method as claimed in any one of claims 27 to 34, wherein said first and second rolls do not re-treat either of the conductive or non-conductive outputs.
36. A method as claimed in any one of claims 27 to 35, wherein there is included a step of passing the non-magnetic output of said first and second rolls to said third roll, while magnetic output of said first and second rolls is passed to a fourth roll.

37. A method as claimed in claim 36, wherein said non-magnetic output from the fourth roll, and the magnetic output from the third roll, join into a single stream with a mid output from the second roll.
38. A method as claimed in any one of claims 27 to 37, wherein said fourth roll is a magnetic cleaner and said third roll is a non-magnetic cleaner.
39. A method as claimed in any one of claims 27 to 35, wherein there is included a step of passing the magnetic output of said first and second rolls to said third roll, while non-magnetic output of said first and second rolls is passed to a fourth roll.
40. A method as claimed in claim 39, wherein said magnetic output from the fourth roll, and the non-magnetic output from the third roll, join into a single stream with a mid output from the second roll.
41. A method as claimed in any one of claims 39 or 40, wherein said third roll is a magnetic cleaner and said fourth roll is a non-magnetic cleaner.
42. A method as claimed in any one of claims 27 to 41, wherein said third roll has a non-magnetic output and a magnetic output.
43. A method as claimed in claim 42, wherein said third roll also includes a mid output.
44. A method as claimed in any one of claims 27 to 43, wherein said fourth roll has a non-magnetic output and a magnetic output.
45. A method as claimed in claim 44, wherein said fourth roll also includes a mid output.
46. A method as claimed in any one of claims 27 to 45, wherein said first and second rolls do not re-treat either of the magnetic or non-magnetic outputs.
47. A method as claimed in any one of claims 27 to 46, wherein said electrostatic separation means includes one or a combination of two or more of the following: an ionising or high tension electrode; tribo-electric mechanism; electrostatic plate separator; or other appropriate means so as to positively or negatively charge or polarise said particulates.
48. A separation plant which operates by a method as claimed in any one of claims 27 to 47.
49. An electrostatic and magnetic mineral separation device having a roll onto which a feed of particulates to be separated can be introduced, said roll including a magnetic means associated therewith to allow magnetic forces to act on said particulates and thereby attract said particulates to said roll, said roll also being conductive and said device including a

- means to electrostatically charge said particulates so that conductive particulates are removed from said roll before non conductive particulates.
50. A device as claimed in claim 49, wherein said roll is manufactured from non magnetic and conductive material.
51. A device as claimed in claim 50, wherein said roll is made from stainless steel or aluminium.
52. A device as claimed in claim 50 or 51, wherein said magnetic means is located within said roll.
53. A device as claimed in claim 52, wherein said magnetic means is stationary with respect to said roll.
54. A device as claimed in claim 52, wherein said magnetic means rotates with said roll.
55. A device as claimed in claim 49 wherein said roll is manufactured from a magnetic material which is also conductive.
56. A device as claimed in claim 55, wherein said roll is manufactured from steel
57. A device as claimed in claim 56, wherein said magnetic means is stationary with respect to said roll.
58. A device as claimed in claim 56, wherein said magnetic means rotates with said roll.
59. A device as claimed in claim 55, wherein said roll is manufactured, at least in part, from a rare earth magnet.
60. A device as claimed in any one of claims 54 to 59, wherein a mechanical means is provided to assist removal of magnetic particulates from said roll.
61. A device as claimed in claim 60, wherein said mechanical means is a belt associated with said roll or a non magnetic scraper to remove magnetic particulates from said roll.
62. A device as claimed in any one of claims 49 to 60 wherein means to electrostatically charge said particulates includes one of or a combination of two or more of the following: an ionising electrode; tribo-electric mechanism; electrostatic plate separator; or other appropriate means so as to positively or negatively charge said particulates.
63. A separation plant including a device as claimed in any one of claims 49 to 62.
64. A device, method or plant as claimed in any one the preceding claims, wherein said magnetic separation and said electrostatic separation occur simultaneously on a respective roll.

65. A device, method or plant as claimed in any one the preceding claims, wherein said magnetic separation and said electrostatic separation occur sequentially on a respective roll.
66. A device, method or plant as claimed in claim 65, wherein magnetic separation occurs first and electrostatic separation occurs second.
67. A device, method or plant as claimed in claim 65, wherein electrostatic separation occurs first and magnetic separation occurs second.